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## (54) A lined clutch plate and a method of producing a lined clutch plate

(57) The present specification discloses a method and apparatus for assembling a clutch plate including forming arcuate segments (28) from a friction material sheet, applying the arcuate segments (28) to a ring (12) in a fixed location with a temporary adherent, preferably to define intermediate spaces (32) between the arcuate segments (28), and bonding the arcuate segments (28) to the annular ring surface (14,16) to form an automatic transmission clutch plate. Preferably, a set (56,62) of multiple arcuate segments (28) with independent edge boundaries (30) are applied in a single workstation (40), and one or more sets (56,62) may be applied to each

annular surface (14,16) by appropriately indexing the ring (12) with respect to the application equipment. Preferably, the arcuate segments (28) are formed by stamping the segments (28) from sheets (44,54), the cuttings arranged at closely spaced positions on the sheet to reduce friction material waste. Preferably, the stamping die displaced the cut arcuate segment (28) to its fixed location on the annular ring (12). The preferred embodiment includes a lined clutch plate (10) in which spaces (32) between adjacent arcuate segments (28) of friction material form lubrication grooves from the radially inner edge (18) to the radially outer edge (20) of the clutch plate ring (12).

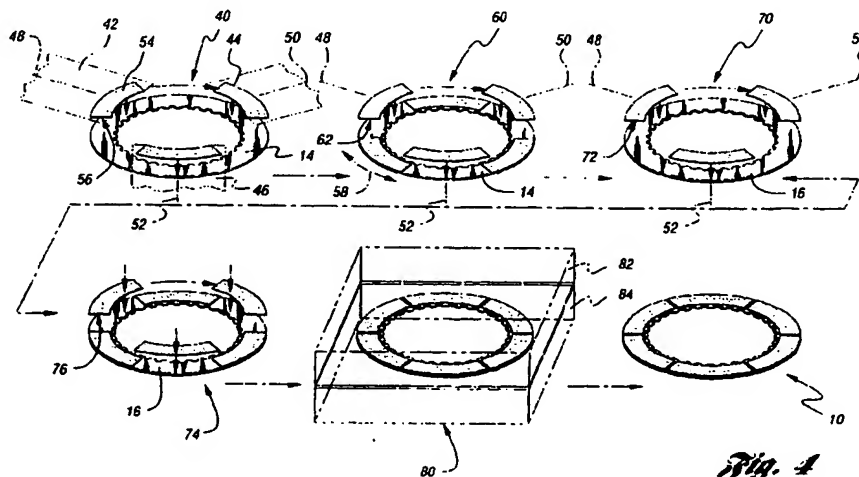


Fig. 4

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## Description

The present invention relates to a method of producing a lined clutch plate, and to a lined clutch plate.

More particularly the present invention relates generally to automatic transmission clutch plates, and especially to the method for forming and applying arcuate segments of friction-lining material to a side of an annular ring and bonding them thereto to form a clutch plate.

Automatic transmission clutch plates are flat annular rings having a friction lining applied to the annular sides. One or both sides are often covered with an annular ring of friction material lining sized for mating engagement with adjacent plates similarly lined. A lubricating medium such as transmission oil may communicate with the lined outer sides of the clutch plates in the clutch plate assembly to control engagement of the adjacent clutch plates. The friction lining was often similarly shaped as an annular ring and the annular ring is cut from sheet material. However, removal of an annular ring from a sheet material leaves a substantial portion of sheet material residue, for example, the circular internal portion and triangular outer portions of the sheet material. As a result, a substantial amount of the sheet of friction material is wasted during the production and assembly of lined clutch plates.

One previously known assembly eliminates the large areas of waste by cutting the friction lining as arcuate segments. However, the previously known process provided arcuate segments having interlocking end portions so that the segments are interconnected for accurate alignment on the sides of the annular ring forming the clutch plate. This interconnection and alignment assures proper installation of the friction lining on the side surface of the clutch plate ring. However, the interconnection of the segments complicates installation of the lining on the plate ring, since each segment must be handled so as to avoid disconnection of the interlocking tabs and slots of the friction lining segments. The connection forms an annular ring of separatable but interconnecting segments that must be transferred simultaneously to the side of the clutch plate ring. Moreover, the friction material must be modified before or after installation to include grooves, for example, by hot molding a plurality of parallel grooves in the friction material sheet, to provide fluid passages for lubrication communication between radially inner and outer edges of the clutch plate.

In addition, it has also been known to extrude a long strand of friction material having a relatively small cross-section. The strand is then sliced into multiple small segments that can be applied to a clutch plate ring. However, such a structure substantially multiplies the number of pieces that must be formed, located and adhered to the ring. Accordingly, such an assembly can increase the opportunity to misalign the segments with respect to the annular shape of the ring and the adjacent segments. In addition, such a construction limits the ability

to configure communication passages as spacings between the sliced segments and limits surface area of exposed friction lining.

## 5 Summary Of The Invention

The present invention overcomes the above-mentioned disadvantages by providing a method for lining a clutch plate ring, and an assembled clutch plate, that includes arcuate segments of friction material lining at spaced, adjacent positions along an annular clutch plate ring. The method improves production by limiting waste of friction material as the arcuate segments can be formed at closely aligned positions to improve the area of the sheet of friction material to be utilized in forming the arcuate segments. In addition, the step of applying a plurality of segments to a side of the disk locates them in spaced, adjacent positions to provide lubrication channels without preforming or otherwise shaping the applied friction material. In addition, the arcuate segments are bonded at the spaced, adjacent positions by an adherent, preferably carried by the ring or the friction material, to be used in forming the clutch plate.

In the preferred embodiment, a plurality of forming presses, each press forming a plurality of segments by stamping from a sheet at closely spaced locations along an elongated sheet of friction material. Preferably, a plurality of presses at a stamping station are aligned at separated positions for applying multiple segments to a single ring. In addition, the station or adjacent stations index the ring so that additional sets of arcuate segments can be applied between previously aligned segments, or on both first and second sides of the ring before the bonding step is executed to adhere the arcuate segments at spaced adjacent locations on the annular ring.

The present invention also provides a lined clutch plate on which an adherent secures a plurality of spaced adjacent arcuate segments on an annular ring, an intermediate portion of the ring between arcuate segments forming a groove for lubrication communication from the radially inner edge to the radially outer edge of the clutch plate. The grooves may be aligned as desired, or avoided if preformed or subsequently formed grooves are available, for example by pressing grooves during the bonding operation, for lubrication passages.

Thus, the present invention avoids the need for complex interlocking relationships between adjacent arcuate segments of lining configured to a clutch plate ring. In addition, the invention improves efficient use of friction material sheets by stamping closely spaced adjacent arcuate segments. Moreover, the forming or applying apparatus segment may be aligned along multiple axes for installing multiple segments at separated positions along the annular ring, and indexing the ring to align multiple sets of arcuate segments at separated positions.

The clutch plate assembly includes channels or grooves between edges of adjacent arcuate segments

to provide lubrication passageways between the radially inner and outer portions of the clutch plate where the friction material is not subjected to a grooving operation. Alternatively, the segments can be closely positioned where grooves are preformed in the friction material or are incorporated after application, for example, during a pressurized bonding operation. In addition, one or both opposing sides of the clutch plate ring can be provided with friction material, the number, size and shape of the arcuate segments being adjustable to improve production efficiency.

### **Brief Description Of The Drawings**

The present invention will be further described, by way of example, with reference to the following detailed description of a preferred embodiment when read in conjunction with the accompanying drawings in which like reference characters refer to like parts throughout the views and in which:

FIGURE 1 is a perspective view of a clutch plate constructed in accordance with the present invention;

FIGURE 2 is a plan view of the clutch plate shown in Figure 1;

FIGURE 3 is a sectional view taken substantially along the line 3-3 in Figure 2; and

FIGURE 4 is a perspective view of workstations performing method steps in accordance with the method of the present invention.

### **Detailed Description of the Preferred Embodiment**

Referring first to Figure 1, a clutch plate 10 is there-shown comprising an annular substrate or ring 12, preferably a metal plate such as steel. The ring 12 has annular sides 14 and 16 between a radially inner edge 18 and a radially outer edge 20. The inner radial edge 18 includes a plurality of splined teeth 22 for engagement with splines in a well known manner for use in automatic transmissions. Also, as is well known, each of the annular sides 14 and 16 of the ring 12 carries a lining 24. Alternatively a lining can be provided on only one side. Also, in an alternative embodiment the teeth 22 are provided on the outer radial edge 20.

As best shown in Figure 2, a lining 24 comprises a plurality of arcuate segments 26. In the preferred embodiment, each segment 28 is sized to cover a portion of the annular surface. For example, a segment length slightly less than about 1/6 of the annular surface 14 or 16 is shown in FIG. 2. In addition, each arcuate segment 28 has radially aligned edges that are substantially parallel to each other, although it is to be understood that the circumferential edges 30 are independent edge

boundaries that can be aligned at other angles or aligned at angles with respect to each other depending upon the need for lubrication passage, the number of spaces, and the directions in which the passages are formed in the spacing 32. For example, an inclined spacing between segments 28 is shown in phantom line at 34. Moreover, lubrication passages may be pressed or otherwise formed in the friction material, whereby the independent edge boundaries, that is, the segment ends without interdigitated tabs and slots, may abut each other.

In the preferred embodiment, the ring 12 is stamped from a coated metal sheet, the coating 36 preferably comprising a commercially available adhesive. The layer of adhesive coating forms a temporary bond when adjacent segments 28 are positioned upon the ring as well as a permanent bond between the lining 24 and the ring 12 when bonded to the ring in a manner to be described in greater detail below. Nevertheless, other methods of interposing an adherent between the lining and the ring 12 are also within the scope of the present invention, and a separate adherent coating step could be performed during the assembly of the lining to the ring. Typically, a thermosetting adherent may be tacky upon partial heating when the segments 28 are engaged against the surface of the ring to fixedly locate the segments in position on the surfaces 14 and 16. The bonding step preferably provides enhanced application of heat under pressure for a time duration in a manner consistent with known bonding processes to permanently bond the lining 24 to the ring 12. Nevertheless, it will be understood that the parameters of time, temperature and pressure may vary as necessary depending on the composition of the friction material, the adherent and the substrate.

Referring now to Figure 4, a workstation 40 is there-shown in which a step of forming arcuate segments 28 of friction material is represented. Preferably, to form segments of the size and shape of segments 28, three sheets 42, 44 and 46 of friction material are shown aligned along mutually spaced feed paths 48, 50 and 52 aligned at 120° to the adjacent paths. Along each path, a cutter such as a stamping die 54 forms an arcuate segment 28 from the respective sheets 42, 44 and 46. At each segment cutting location, the stamping can be displaced toward the ring, for example, by movement of the die, and pressed into a fixed location on the annular surface 14 of the ring 12. During pressing the first set 56 of the multiple segments 28, the segments 28 are positioned in registration with the centerline of paths 48, 50 and 52 to cover separated portions of the surface 14.

A station 60, as shown in Fig. 4, the first set 56 of segments 28 are shown indexed by rotation of the ring as shown diagrammatically by arrow 58 so that the unlined surface portions of the ring 12 are aligned along the axes 48, 50 and 52, respectively. Accordingly, a second set 62 of arcuate segments 28 are stamped and applied to the surface 14 at locations intermediate the

segment locations of the first set 56. Of course, it is to be understood that the stations 40 and 60 are not necessarily physically separated, and may represent two functional modes of a single work station. In addition, the number of segments and total number of stations utilized is optional.

Additional but optional forming and applying steps are represented at station 70 where a third set 72 of arcuate segments 28 are applied to the opposite side annular surface 16 of the ring 12 after an indexing operation exposes the surface 16, for example, flipping the ring on its fixture. Similarly, at station 74, a fourth set 76 of arcuate segments 28 is applied after rotary indexing of the ring, preferably similar to that described with reference to station 60, to apply a fourth set 76 at locations intermediate the locations of segments in the first set 72 of arcuate segments 28 on the surface 16.

When all of the arcuate segments of friction material have been applied, and temporarily held in fixed locations, that preferably define the intermediate spaces forming lubrication passages when the friction material is not grooved or not to be grooved during bonding, the assembled clutch plate is prepared for bonding by delivery to a station 80 at which heat and pressure are applied to the composite in a well known manner. The assembled clutch plate 10 is then ready for assembly with other clutch plates in an automatic transmission in a well known manner.

Having thus described the present invention, many modifications thereto will become apparent to those skilled in the art to which it pertains without departing from the scope and spirit of the present invention as defined in the appended claims. For example, sheets of friction material may already have preformed grooves, so that the spaces 32 may be eliminated and that the edges 30 of each arcuate segment will be applied to abut against each other for enhancing the exposed area of friction material on the clutch plate. In addition, the size and number of arcuate segments and the sequence of steps used in forming and applying the arcuate segments of friction material may be varied without departing from the scope and spirit of the present invention as defined in the appended claims.

#### Claims

1. A method for lining annular sides (14,16) of clutch plates (10) with friction material, comprising:

forming arcuate segments (28) from a sheet of friction material;  
 applying a plurality of segments (28) at spaced, adjacent positions upon at least one side (14,16) of an annular ring (12) to form intermediate channels (33) between said arcuate segments (28); and  
 bonding said plurality of segments (28) at said

spaced, adjacent positions.

2. A method as claimed in claim 1, wherein said forming step comprises stamping arcuate segments (28).
3. A method as claimed in claim 2, wherein said arcuate segments (28) are stamped from closely adjacent strip portions (42,44,46) of said sheet.
4. A method as claimed in claim 1, wherein said forming step comprises sequentially stamping at least one elongated strip having closely adjacent arcuate strip portions.
5. A method as claimed in claim 1, wherein said forming step comprises simultaneously forming a plurality (26) of said segments (28) in alignment with said spaced, adjacent positions.
6. A method as claimed in claim 1, wherein said applying step comprises pressing a plurality of segments (28) upon said clutch plate ring (12) mutually spaced positions.
7. A method as claimed in claim 1, wherein said spaced positions are arranged in a plurality of sets (56,62) and said applying step comprises applying a first set (56) of segments (28) before applying a second set (62) of segments (28) at positions intermediate said positions of said first set (56).
8. A method as claimed in claim 7, wherein said first set (56) comprises mutually separated segments (28).
9. A method as claimed in claim 6, wherein said applying step comprises pressing a plurality of segments (28) on opposite sides (14,16) of said clutch plate ring (12).
10. A method as claimed in claim 1, wherein said bonding step comprises pressurized engagement of said segments (28) against said clutch plate ring (12).
11. A method as claimed in claim 1, wherein said pressing step comprises heating at least one of said segments (28) and said clutch plate ring (12).
12. A method as claimed in claim 1, wherein said pressing step includes limiting said pressing step for a predetermined time duration.
13. A lined clutch plate comprising:  

an annular ring (12) having first and second sides (14,16); at least one of said first and second sides (14,16) having a friction lining (26)

comprising at least one set (56,62) of a plurality of spaced, adjacent arcuate segments (28), an intermediate space portion (32) of the ring surface (14,16) forming a groove intermediate adjacent segments (26) at said space (32); and an adherent between said at least one of said first and second sides (14,16) and each said at least one set (56,62) of arcuate segments (28).

14. A clutch plate as claimed in claim 13, wherein said adherent is a coating on at least one of said annular ring (12) and said arcuate segment (28).

15. A clutch plate as claimed in claim 14, wherein said annular ring (12) is a coated substrate and wherein said coating is said adherent.

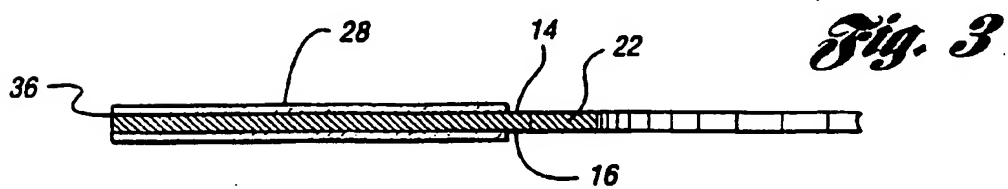
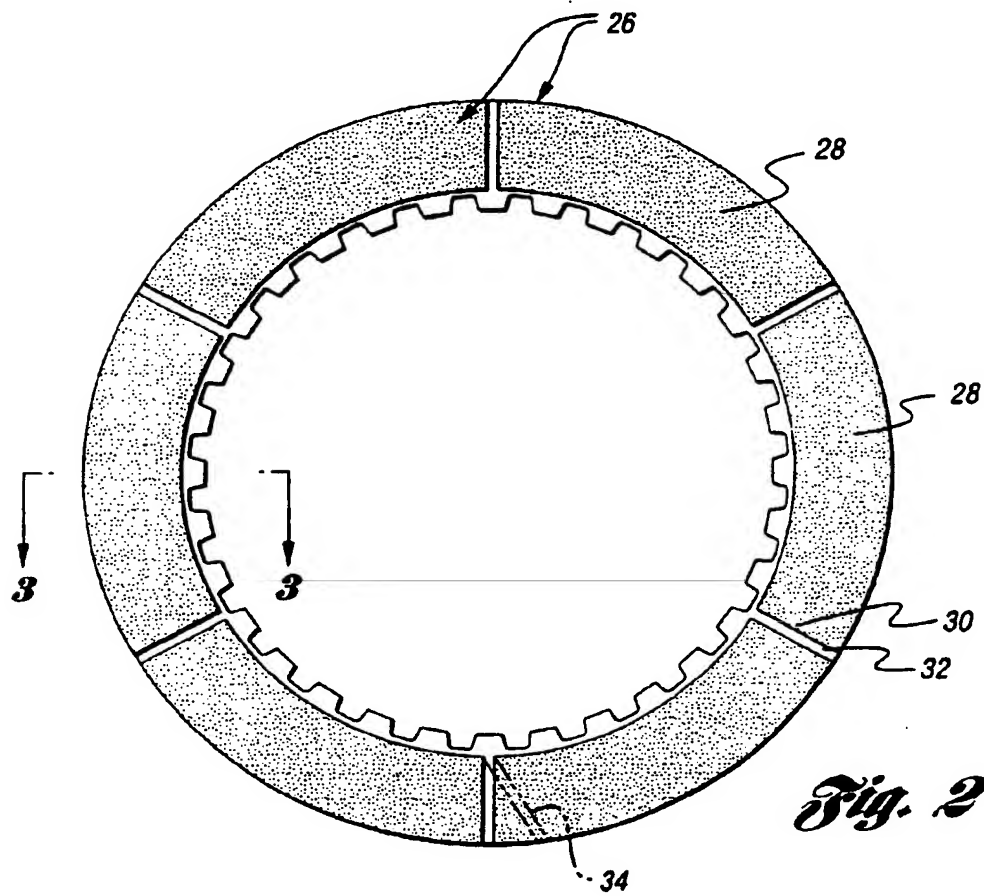
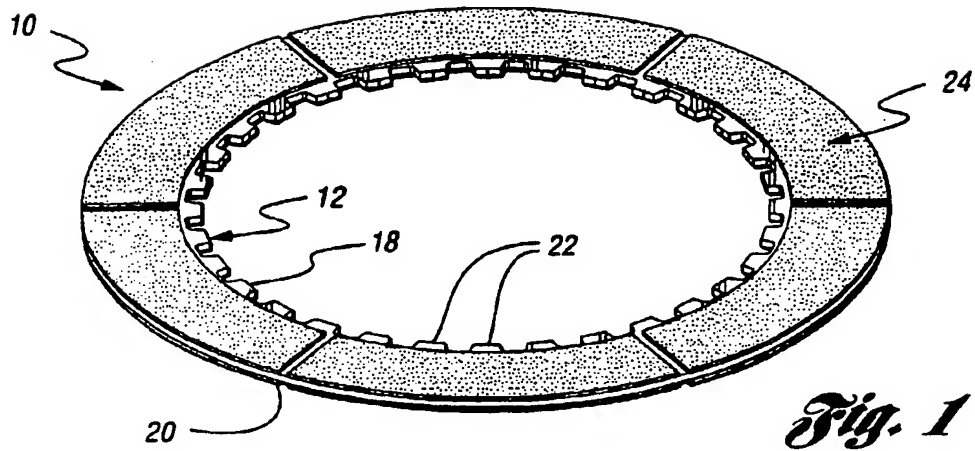
16. A clutch plate as claimed in claim 13, wherein said groove (32) is radially aligned with respect to said annular ring (12).

17. A clutch plate as claimed in claim 13, wherein said groove (32) is aligned by parallel edges (30) of said arcuate segments (28).

18. A clutch plate as claimed in claim 13, wherein said first and second sides (14,16) each form a friction lining comprising a plurality of spaced, adjacent arcuate segments (28).

19. A lined clutch plate comprising:

an annular ring (12) having first and second sides (14,16); at least one of said first and second sides (14,16) having a friction lining comprising at least one set (56,62) of a plurality of arcuate segments (28), each segment (28) having an independent edge boundary (30) at each circumferential end;  
an adherent between said at least one of said first and second sides (14,16) and each said at least one set (56,62) of arcuate segments (28); and  
lubricant passages (32) formed by at least one of grooves in said friction lining and spacing (32) between said independent edge boundaries (30).



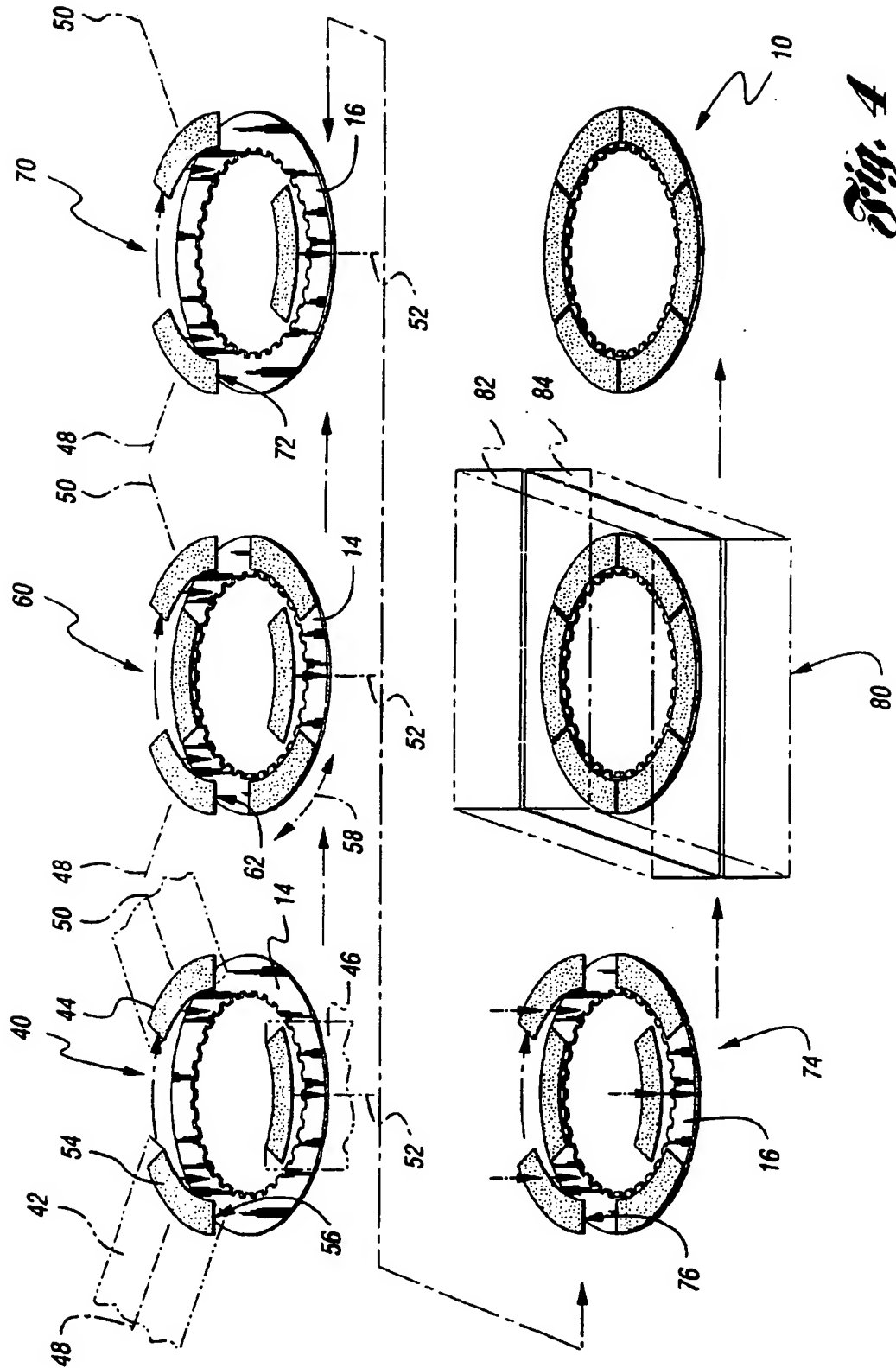


Fig. 4

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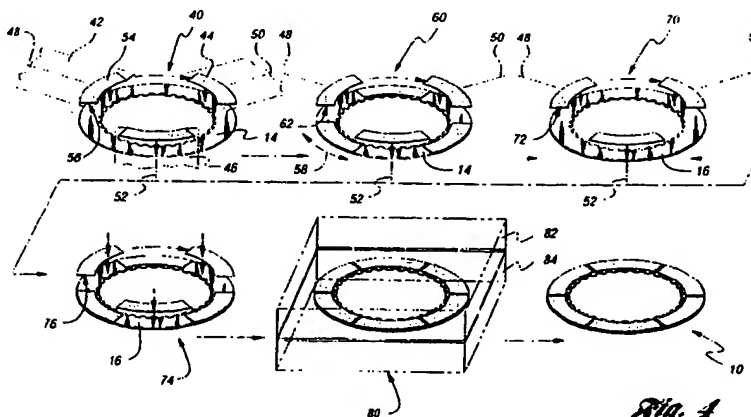
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annular surface (14,16) by appropriately indexing the ring (12) with respect to the application equipment. Preferably, the arcuate segments (28) are formed by stamping the segments (28) from sheets (44,54), the cuttings arranged at closely spaced positions on the sheet to reduce friction material waste. Preferably, the stamping die displaced the cut arcuate segment (28) to its fixed location on the annular ring (12). The preferred embodiment includes a lined clutch plate (10) in which spaces (32) between adjacent arcuate segments (28) of friction material form lubrication grooves from the radially inner edge (18) to the radially outer edge (20) of the clutch plate ring (12).



*Fig. 1*





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# EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 2931

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	EP 0 625 647 A (BORG WARNER AUTOMOTIVE) 23 November 1994 * the whole document *	1-4,13, 16,18,19	F16D69/04 F16D13/64
X	US 5 094 331 A (FUJIMOTO KATSUMI ET AL) 10 March 1992 * column 9, line 55 - line 68 * * column 14, line 5 - line 6; figures 6-8,17 *	1,13, 16-19	
X	EP 0 030 791 A (GEN MOTORS CORP) 24 June 1981 * the whole document *	19	
A		1-4, 13-15	
X	PATENT ABSTRACTS OF JAPAN vol. 10, no. 10 (M-446) [2067] , 16 January 1986 & JP 60 172727 A (FUJI KAGAKU KOGYO K.K.), 6 September 1985, * abstract *	13,19	
A	FR 2 254 984 A (BORG-WARNER CO.) 11 July 1975 * page 2, line 11 - page 3, line 20; figures 1-3 *	10-12	
The present search report has been drawn up for all claims			
Place of search <b>THE HAGUE</b>		Date of completion of the search <b>9 October 1997</b>	Examiner <b>Van Overbeeke, J</b>
<b>CATEGORY OF CITED DOCUMENTS</b> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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